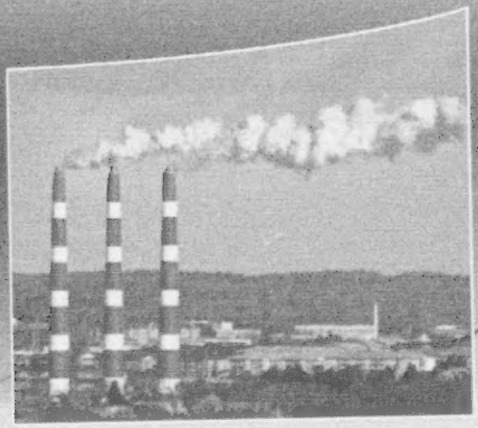
Environment Canada Environnement Canada

Air Quality Health Index

Classroom Kit – Grades 5 and 6

BOOK II: ENVIRONMENT

Lesson plans to explore air quality, electricity, and natural resources



Canada

Acknowledgements:

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BC Ministry of Environment, BC Transit, and Environment Canada. (2005). A Teacher's Guide to Clean Air. www.transitbc.com/clean_air/.

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Quick Reference Guide

Lesson	1: Plug it in? Breathe it in! The environmental impacts of producing electricity	2: Air quality and the environment: Tracking our actions back to the earth's resources
Summary	This lesson uses comic strips, rotating placemats, and sticky concept maps to teach students about how electricity connects to air quality. Topics include Air Quality Health Index (AQHI), renewable and non-renewable resources, emerging technologies, air pollution, and fossil fuels.	This lesson connects everyday choices to renewable and non-renewable sources of energy. Short, focused activities keep students' attention as they learn about air quality, fossil fuels, and electricity.
Page	2	21
Materials	• Projector • Chart paper • 2 or 3 Post-it® note pads • Markers (8)	• Petroleum jelly • White paper/card stock OR large and small jars • Chart paper • Markers
Preparation	• Introducing the Clean Air Heroes (p.4; projected) • Rotating Placemat Activity (p.5–6; 1 per group of four) • Sticky Concept Maps (p.7; 1 per group) • Group Readings (p.8–17; 1 per group) • Comic Strip Assignment (p.18; 1 per student)	**One Week Ahead**: Set up for visible pollution (See Instructions) **Before Class:** Prepare chart paper (See Instructions) • Hands Up (p.23; projected) • Carousel Readings (p.24–32; 1 per group) • Air Quality Report (p.33–34: 1 per student)
Curricular Theme	Living and non-living resources; Renewable and non-renewable sources of electrical energy	Living and non-living resources; Renewable and non-renewable sources of electrical energy

1: Plug it in? Breathe it in! The environmental impacts of producing electricity

This lesson uses comic strips, rotating placemats, and sticky concept maps to teach students about how electricity connects to air quality. Topics include Air Quality Health Index (AQHI), renewable and non-renewable resources, emerging technologies, air pollution, and fossil fuels.

Materials

- Projector
- Chart paper
- 2 or 3 Post-it® note pads
- Markers (8)

Preparation

- Introducing the Clean Air Crusaders (p.4; Overhead)
- Rotating Placemat OR large chart paper (p.5–6; 1 per group)
- Sticky Concept Maps (p.7; 1 per group)
- Group Readings (p.8–17; 1 per group)
- Comic Strip Assignment (p.18; 1 per student)

Real World Connections

- Understanding that electricity is generated in many different ways and that some produce less air pollution than others;
- Awareness that the AQHI in Environment Canada's daily forecast is a reflection of local air quality and can be used to inform choices.

Curricular Themes

- Renewable and non-renewable sources of electrical energy

For a list of learning outcomes, please refer to the end of this document.

Setting the Stage

1. **Display Overhead 1: Introducing the Clean Air Heroes.**

2. **Ask:** What do you think it is asking? What do they mean by this?

Elicitation: Rotating Placemat Activity (10 min)

3. **Divide** students into groups of four, seated in a circle or around a table. Assign each group with a different method of producing electricity, particularly those that are locally relevant. For example: burning coal in power plants, hydroelectric dams, tidal, windmills, solar panels, biomass, geothermal.

4. **Provide** each group with an enlargement of **Handout 1: Rotating Placemat** or divide a piece of chart paper as indicated.

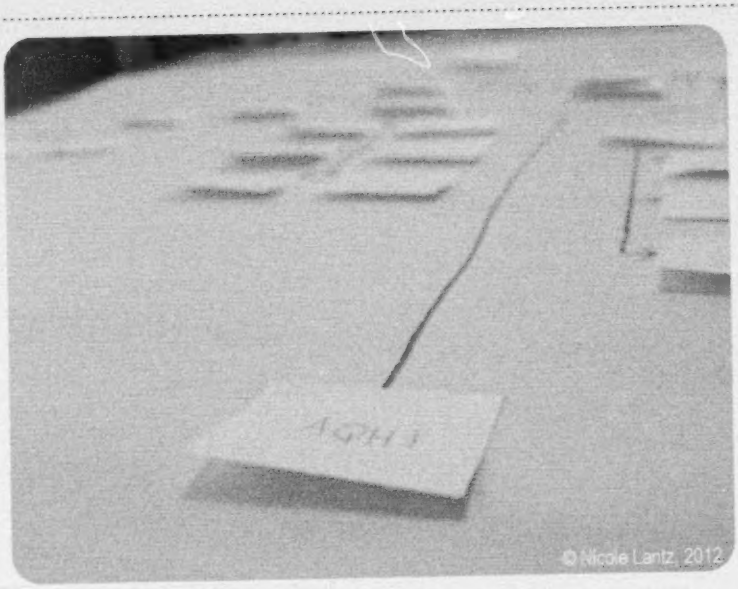
5. **Read and discuss** instructions and carry out the activity, either informally or giving set times to rotate the mat (e.g. 1 min).

6. **Ask** each group to share something from each section of their handout (e.g. one plus (+), minus (-), and interesting (I)).

Restructuring: Consensus-building Concept Maps (30 to 40 min)

7. **Divide** your class by eight (8) to arrange small groups.

8. **Pass out Sticky Concept Maps** and **Group Readings**, chart paper, Post-it® notes and a marker.



9. **Review** instructions with the class. Then, circulate and monitor progress.

10. **Combine small groups**. You should have four (4) medium-sized groups. Ask students to review concept maps and collaborate to revise them and build consensus.

11. **Combine medium groups** to make two (2) large groups and facilitate consensus-building.

12. **Combine large groups** and facilitate consensus-building for the full class.

Application and Conclusion (15 to 90 min)

13. **Pass out Handout 4: Comic Strip Assignment**. **Read** and **discuss** the instructions with students. **Decide** if students will be able to complete the entire assignment in class or finish it at home.

14. **Show** students **Overhead 1: Introducing the Clean Air Crusaders** again.

15. **Ask** for ideas about what the comics might mean in a full-class discussion.

Timesaver Adaptation

(Modified Jigsaw: 5 to 10 min)

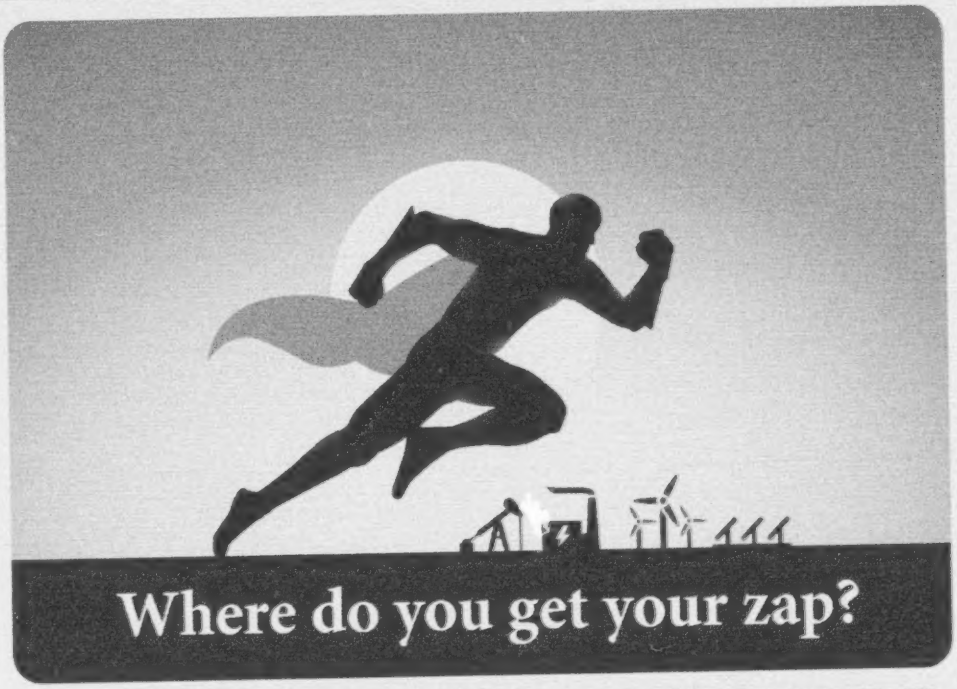
- **Number** students, one to four.
- **Assign** each number a method of producing electricity (rather than each group).
- **Give** each student a copy of **Handout 1: Rotating Placemat** and have them rotate it themselves to complete each section.
- **Ask** students to share one plus, minus, and interesting item with a partner.

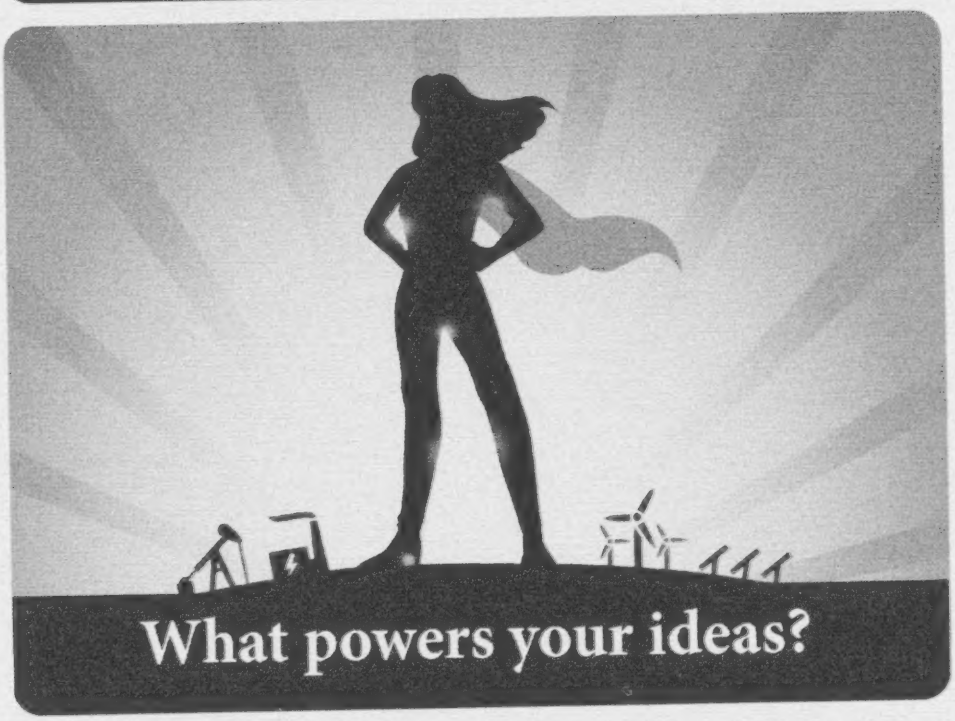
Teacher Tips

- Let students work in pairs to brainstorm ideas before they get started.
- Decide if students will be able to complete the entire assignment in class or finish it at home.
- In-class differentiated instruction: pair students with stronger artistic abilities with those with a better grasp of science concepts.
- Make use of online educational cartooning software to add a technology component.

Introducing the Clean Air Heroes

animate





Rotating Placemat

1 Think about the *environmental impact* when people **get, prepare, and use natural resources to make electricity.**

2 **Turning the Placemat**

Write in the section in front of you. Then, rotate the mat and write in another section. Repeat the process until you get your own section back.

3 **Plus, Minus, Interesting**

Under each topic, organize your ideas under plus (+), minus (-), or interesting (I).

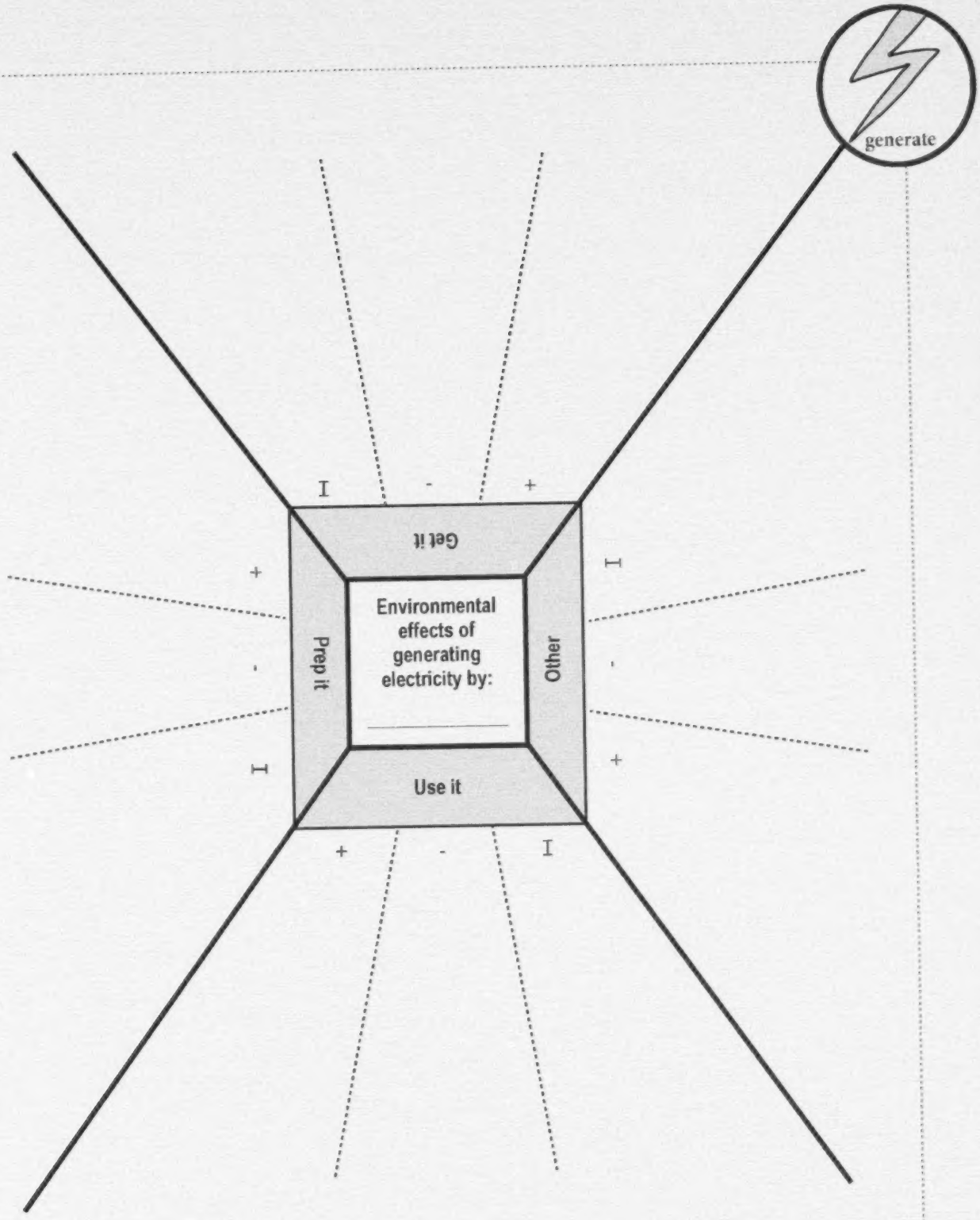
- **Plus:** Sentences or questions that support the topic.
- **Minus:** Sentences or questions against the topic.
- **Interesting:** Any interesting idea.

4 **Extracting, preparing, and using natural resources to generate electricity**

- **Get it:** Think about how **natural resources** are **harvested** or **extracted**. What pollution happens here?
- **Prep it:** Does the generation station use raw materials or do **natural resources** have to be processed first? Is any construction necessary? What pollution happens here?
- **Use it:** What pollution is caused when the **electricity** is made? Are there other environmental effects?
- **Other:** What things do you hear about it in the news, from family, etc.?

Did You Know?

Environmental impact is the effect, usually negative, of a human activity on a local area.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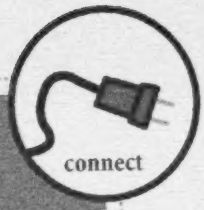

Sticky Concept Maps

Air pollution is one environmental effect of making electricity. Here, you will sort out how electricity is connected to the Canadian Air Quality Health Index (AQHI).

SMALL GROUPS

1 **Write** each of the following words on Post-it® notes. Place them on chart paper. Guess how they are connected.

- Electricity
- Renewable
- Non-renewable
- Natural resources
- Air pollution
- Harvesting
- Extracting
- Fossil fuels
- Geothermal
- Tidal
- Solar
- Hydro
- Wind
- Biomass
- Coal
- Oil
- Natural gas
- Environmental impacts
- Smog
- Particulate matter (PM)
- Ground-level ozone (O_3)
- Volatile organic compounds (VOCs)
- Nitrogen oxides (NO_x)
- AQHI

2 **Scan** the readings quickly to decide which ones you will read first and how you will divide the work. Will you read all of them out loud, or will you each read one?

3 **Read and look** for the words in the word list. You may even want to highlight them. As you read, **sort** the words into groups by moving the Post-it® notes around on the bristol board. Talk it out, explaining your reasons for grouping the words together. This will help you with your concept map.

4 **Re-read** the information to fill in details.

5 **Join** with another group. Talk through the concept maps to find the differences.

6 **Revise** the maps until you agree.

Reading Strategy

- **Read** the title.
- **Look** for clues, bold words, or pictures.
- **Question**: What does this mean?
- **Highlight** the words you don't know.
- **Read** the first sentence of each section.
- **Read** the entire article.

connect

A. What happens when we extract, process, and burn fossil fuels to generate electricity?

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Fossil fuels are non-renewable natural resources such as coal, oil, and natural gas, formed from the remains of ancient plant and animal life.

EXTRACTING AND PROCESSING FOSSIL FUELS:

VOCs

The processes of **extracting**, processing and storing **fossil fuels** have environmental effects. For example, some **fossil fuels** can evaporate. This means that it goes from a liquid to a gas and becomes a pollutant in the air we breathe. Sometimes we can smell the pollutant in the air, like at a gas station. The word *volatile* means "goes into the air," so when this happens the pollutants are called **volatile organic compounds (VOCs)**.

NO_x

BURNING FOSSIL FUELS:

When we burn **fossil fuels**, we make air pollution that affects human health and the environment.

connect

What burns **fossil fuels**?

- Motor vehicles, marine vessels and airplanes
- Power plants (generation of electricity)
- Factories
- Space heating (**oil** and **gas** furnaces)
- Gas-powered garden tools

ADDING IT UP:

When **VOCs** combine with NO_x, it can make **ground-level ozone**.

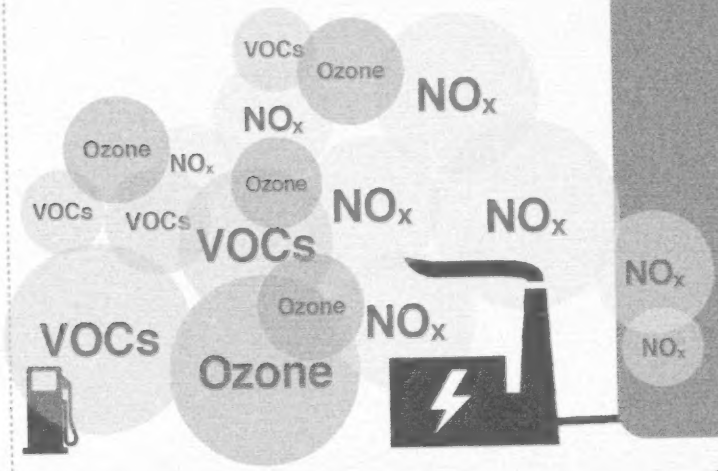
Common Air Pollutants

- carbon dioxide
- methane
- volatile organic compounds (VOCs)
- particulate matter (PM)
- NO_x (nitrogen oxides)
- sulphur dioxide
- carbon monoxide

Did You Know?

Some air pollutants are greenhouse gases. These cause changes in the global **climate**. Not all air pollutants are greenhouse gases, and not all greenhouse gases are air pollutants.

Actions that reduce **air pollution** may also reduce greenhouse gas emissions.



B. Particulate Matter

In winter, wood stoves can be running full blast in an entire community. The amount of particulate matter in the air can reach very high levels.

Particulate matter can be small or very, very small

Particulate matter (PM) is any speck of solid or drop of liquid so small it floats in the air. Sometimes, it is visible (smoke, soot or dust). Other times, it is so small is seems invisible. It can only be seen with a powerful microscope.

PM is so small that we breathe it into our nose or throat without even seeing it. Some PM travels deep into the lungs, causing illness.

Particulate matter comes from many places

PM is produced *directly* from **renewable** and **non-renewable** sources. The main sources from people are wood burning, such as wood stoves and forest fires (**renewable**), and diesel for off-road vehicles (**non-renewable**).

Road salt

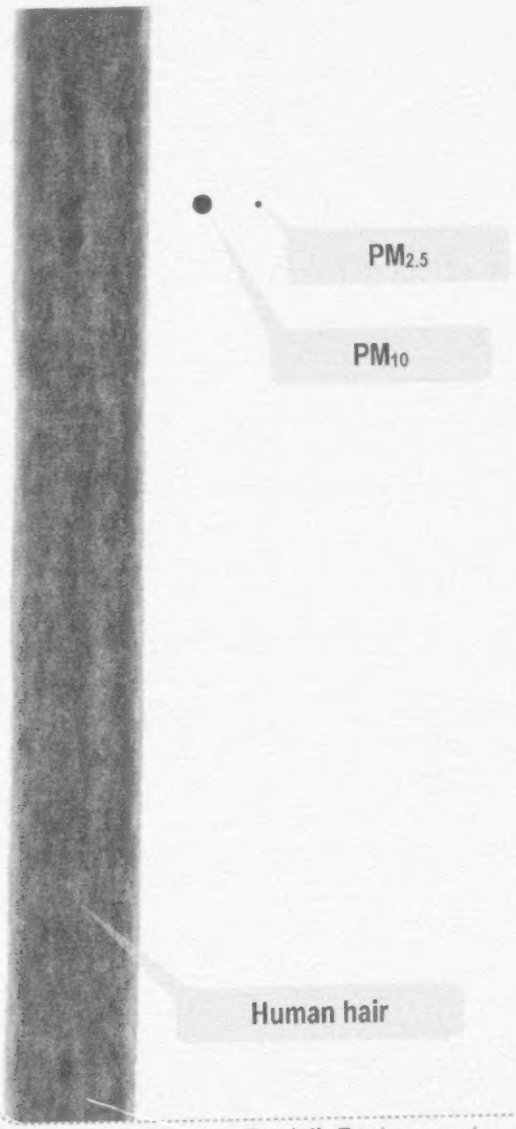
Another source of PM during **winter** is road salt.

Electricity

A direct source of PM is burning **fossil fuels (non-renewable)** or **biomass (renewable)** to make electricity. **Biomass** power plants burn lumber, agricultural waste, building waste, or wood waste. Special equipment can be used to avoid putting **PM** out into the air.

Particulate Matter gets into the lungs

In some provinces and territories, **PM** is the most serious kind of local **air pollution**. It can be more dangerous to human health than ground-level **ozone** and other air pollutants.



How Small Is Small?

- PM is so small, it is measured in micrometres (μm). Look at a ruler and find the millimeters. Micrometres are so small you can fit 1000 of them in one millimetre!
- PM that has a diameter of 10 μm or less is called PM_{10}. It is seven times smaller than the width of a human hair.
- $PM_{2.5}$ has a diameter of 2.5 μm.

Did You Know?

No safe level has been identified for PM. People with respiratory problems may be affected by even a small decrease in air quality.

connect

C. Ground-Level Ozone

NO_x forms in the air when fossil fuels are burned. It is one of the gases that react to make ground-level ozone.

You could say that there are two kinds of ozone: good and bad.

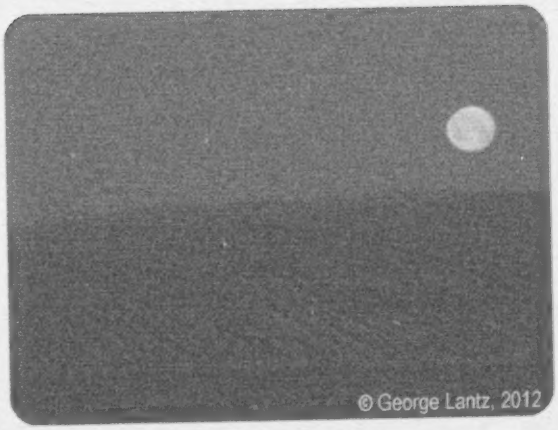
The good ozone is in the stratosphere, floating 25 kilometres above our head. This "ozone layer" protects life on Earth. It is the planet's natural sun-screen, shielding it from the sun's harmful ultraviolet (UV) rays.

The bad kind of ozone is **ground-level ozone**. This ozone is produced in the air closest to the earth's surface (the troposphere). **Ground-level ozone** is one of the two main unhealthy parts of **smog**. Smog also contains PM.

Ground-level ozone is formed in the air.

It takes two things to make ground-level ozone: VOCs and NO_x. **VOCs** are fumes that get into the air when liquid chemicals evaporate. You can sometimes smell them in the air. **NO_x** is a gas that forms in the air when **fossil fuels** are burned.

Ground-level ozone is formed in the air when **VOCs** react with **NO_x**. This often happens when it is sunny and warm.



Ground-level ozone is found in the city and in the countryside.

Ground-level ozone collects over cities and builds up when the air is still. If there is **wind**, it carries the ground-level ozone a few hundred kilometres into the countryside.

Ground-level ozone hurts plants.

Ground-level ozone can damage leaves and prevent plants from growing well. It can make it hard for plants to survive insects and disease. When ozone levels are fairly high for a long time, food crops and other agriculture can suffer.

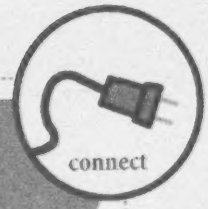
The solution is in our hands.

Every person can help bring the fresh air back. That's because we each create pollution in the first place: the exhaust from our automobiles is the number-one cause. Even if each of us leaves the car at home just once a week, we will reduce air **pollution**. Also, think about switching to cleaner fuels and cleaner ways of generating electricity.

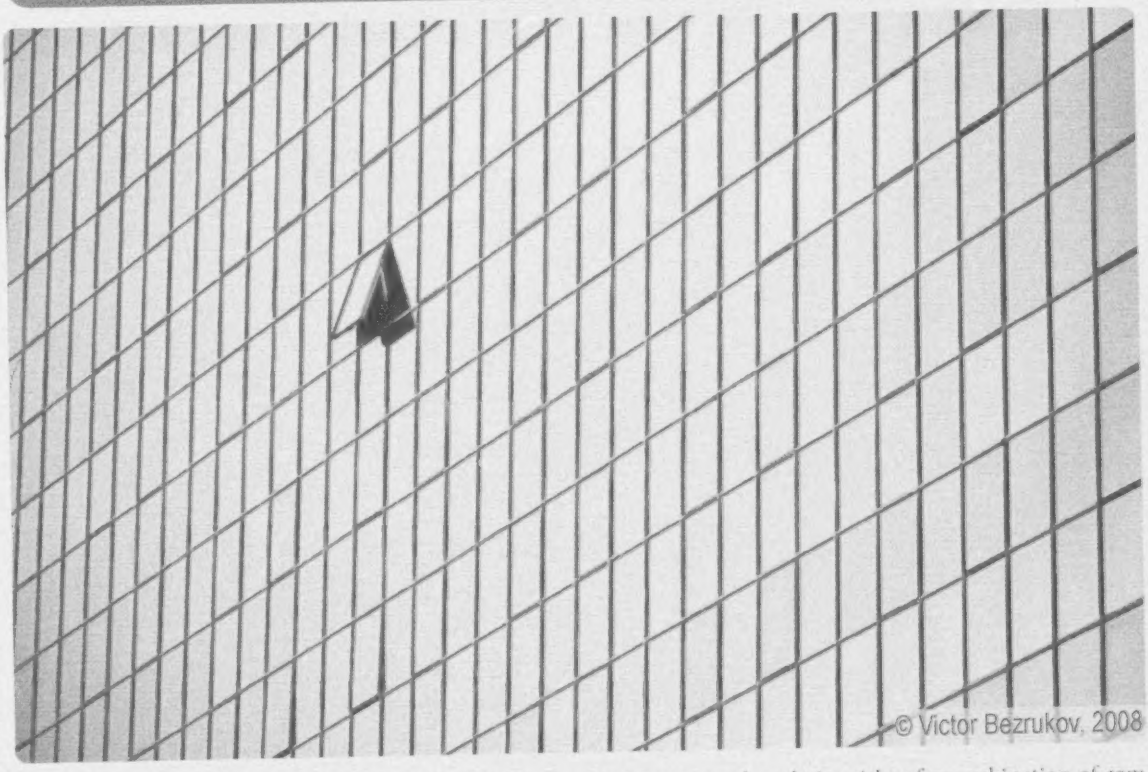
connect

Zap It!

Most clouds are formed in the troposphere, where weather takes place. Is good ozone above or below the clouds? What about bad ozone?



D. Air Quality Health Index



Since people cannot necessarily *see* poor air quality, Environment Canada and Health Canada created an index to help Canadians make decisions about exposure to air pollution. This is called the Air Quality Health Index (AQHI).

The AQHI is calculated based on the relative risks of a combination of common air pollutants that are known to harm human health.

The **AQHI** includes three (3) pollutants that can be in the air in urban or rural areas at any time of year:

- **Particulate matter ($PM_{2.5}$)**,
- **Ground-level ozone (O_3)**, and
- **Nitrogen dioxide (NO_2)**.

How to use the AQHI

Look at the number and colour of the **AQHI** in the daily forecast on Environment Canada's **weather** website. It gives hourly **AQHI** readings and maximum forecasted values for today, tonight, and tomorrow.

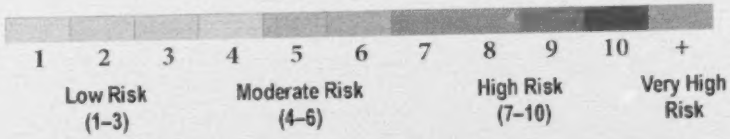
The **AQHI** goes from 1 to 10. The higher the number, the greater the health risk from **air pollution** (e.g. Low, Moderate, High, or Very High Health Risk). It is helpful because it tells Canadians if the current air quality is ideal for outdoor activities or if they need to consider reducing the intensity of

these outdoor activities. It even has direct health information for children and other groups at risk. By using the **AQHI**, you can protect your health, have an active lifestyle and reduce **air pollution** – all at the same time! After all, the best way not to be *exposed* to **air pollution** is not to *make* **air pollution**.

connect

Zap It!

- Why are children considered an at-risk group?



Health Risk	AQHI	Health Messages	
		At Risk Population	General Population
Low	1–3	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities.
Moderate	4–6	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing or throat irritation.
High	7–10	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High	Above 10	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

For more information about the AQHI, go to www.airhealth.ca.

connect

E. Electricity from Natural Resources

Think of the environment. It is usually better to choose renewable resources to make electricity. But even renewable resources cause pollution. It is best to reduce how much electricity we use.

Electricity can be made using renewable resources or non-renewable resources.

There are many people in Canada trying to make electricity with less impact on the environment. This will help improve air quality and lower the AQHI.

There are many ways to make electricity using renewable energy.

1 Use Energy from Heat

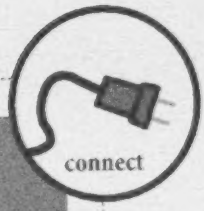
BIOMASS: Burn **biomass** to turn a wheel and make **electricity.**

GEOTHERMAL: Use heat from deep in the earth to produce steam that generates **electricity.**

SOLAR: Use the sun's heat energy to make **electricity.**

2 Use Energy from Light

SOLAR: Use the sun's light energy to make electricity.



3 Use Energy from Height

HYDRO: Use the flow of water from high ground to lower ground to turn a wheel and make **electricity.**

4 Use Energy from Motion

INSTREAM: Let a stream turn a wheel to make **electricity** without needing a dam.

TIDAL: Let the coming and going of the tides turn a wheel and make **electricity**.

WIND: Let the **wind** turn a wheel to make **electricity.**

Zap It!

Energy is not created or destroyed, so you need energy to make **electricity**. The key is finding sources of energy that have the least impact on the environment.

- What would be the perfect source of energy?
- Would it use a living or non-living resource?

Did You Know?

In Canada, most electricity is made using **hydro.** After that, the most popular is steam, **nuclear,** combustion turbines, **wind,** internal combustion, and **tidal**[1].

[1] Canadian Electricity Association. (n.d.). Electricity 101. [PDF document]. www.electricity.ca/media/Electricity101/Electricity101.pdf.

Comic Strip Assignment

Use a comic strip to show your understanding of the environmental effects of **renewable** and/or **non-renewable** sources of electrical energy. Bring the scene to life using dialogue, poses, and emotions. Think about how this affects you and/or your community. Reflect on how personal choices ultimately impact the environment. You can make up your own characters or use the **Clean Air Heroes**.

You must include:

- A single or multi-frame comic strip;
- Character(s) with dialogue or thought bubbles;
- Appropriate language and illustrations;
- Proper spelling, grammar, and usage.

Comics featuring superheroes have been used for social causes for over 70 years.

Political and cultural history has helped shape the course of comics. In the 1930s, the superheroes were rebels and vigilantes. In the World War II era, patriotic heroes were developed. Heroes such as Wonder Woman served as role models for children, encouraging donations for the war effort.

Since then, superheroes have gained prominence in raising awareness about the dangers of drugs, guns, and land mines. The superhero comic characters were chosen to help deliver the message about clean air.

Assessment Criteria

Identifies at least one **renewable** or **non-renewable** source of electrical energy.	/1
Critiques or supports choosing **renewable** and/or **non-renewable** resources to generate **electricity**, based on their environmental effects.	/4
Demonstrates reflection on the content of the lesson. Ideas are creatively and carefully executed.	/5
Includes character(s) with dialogue or thought bubbles. Emotions or poses are used to convey meaning.	/5
Writing follows proper spelling, grammar, and usage. Illustrations are appropriate and are included as a single or multi-frame comic strip.	/5
TOTAL	/20

Enrichment Activities

Particulate matter

PM_{10} collects in the nose and throat. The body tries to get rid of PM_{10} by sneezing and coughing.

$PM_{2.5}$ is so light that it can travel deep into lungs through the trachea and bronchi. It collects in tiny air sacs (alveoli) where oxygen enters the bloodstream. This can cause coughing or wheezing and long-term illnesses. $PM_{2.5}$ also contains harmful chemicals. These chemicals are delivered straight to our blood through our respiratory system.

1. Map out the path of PM through the respiratory system.

See how air pollution moves around

Orange dye and water can help us understand **air pollution**. Imagine pouring a litre of orange dye into the ocean. The color will stay for a few seconds. As soon as the waves come, the orange dye will be mixed with the water in the huge ocean. It's not just the amount of water that dilutes the dye, it's also the mixing by the waves.

Now think of pouring the same amount of orange dye into a bathtub. The bath water will turn very orange. The orange color won't be washed away because it's trapped in the bathtub, in a small amount of water, and there can be no mixing with clean water.

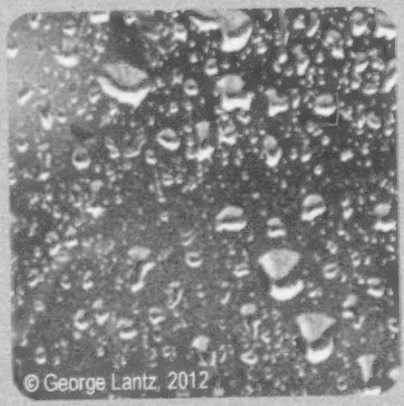
You can try this on a smaller scale using eye droppers, glass bottles, and buckets. Think about how you can make the simulation.

If air pollutants are in a large area with good airflow, they will mix with the air. Then they quickly separate and go in different directions, like the orange dye in the ocean.

However, pollutants can build up or be trapped in an area and build up, just like the dye in the bathtub. This can happen when there is no **wind**, the **weather** is calm and **pollution** stays in one place. It can also happen when hills and valleys trap pollutants. The outcome is poor air quality. That is why the **AQHI** can be higher in towns or cities that are surrounded by hills or mountains.

Air quality can improve during precipitation. **Rain** can "wash" **pollution** out of the sky. This is sometimes called "**rainout**". In fact, when it is sunny and warm outside with fairly light **winds**, the air

Could you label this diagram to show $PM_{2.5}$ and PM_{10} in the respiratory system?



Rain can "wash" **pollution** out of the sky, but where does it go?

Zap It!

What is it called when the dye goes from a higher concentration (the dish) to a lower concentration (the ocean or tub)?

quality is often worse than when it is **raining**. This is because the UV from the sun is needed for one of the chemical reactions for ground-level **ozone**. The direction of the **wind** also plays a big role in long-range transportation of **air pollution** and the resulting **AQHI**.

2. A polluting town located on a hill consistently claims that its high emissions are not causing air quality problems. The town mayor claims:

"Once the pollutants are diluted by the weather and carried away from the site of production, they are no longer a problem. We measured our air quality last week and it was fine."

You are scheduled to speak at a community meeting in the town because air quality is a major problem where you live. Since this is quite far away, the mayor doesn't think it matters what you say. Write speaking notes for the meeting with the town's mayor. You must support your statements with scientific facts.

2: Air quality and the environment

This lesson involves tracking our actions back to the earth's resources. It connects everyday choices to renewable and non-renewable sources of energy. Short, focused activities keep students' attention as they learn about air quality, fossil fuels, and electricity.

Materials

- Petroleum jelly
- White paper/card stock OR large and small jars
- Chart paper
- Markers

Preparation

- *One Week Ahead:* Set up for visible pollution
- *Before Class:* Prepare chart paper
- Hands Up (p.23; Overhead)
- Carousel Readings (p.24–32; 1 per station)
- Air Quality Report (p.33–34; 1 per student)

Real World Connections

- Understanding how personal choices can improve air quality, and how that traces back to both renewable and non-renewable energy.
- Awareness that the AQHI in Environment Canada's daily forecast is a reflection of local air quality and can be used to inform choices.
- Differentiating between technologies available to generate electricity and the root source of that energy (renewable and non-renewable resources).

Curricular Themes

- Renewable and non-renewable sources of electrical energy

For a list of learning outcomes, please refer to the end of this document.

At least one (1) week ahead: Set up for visible pollution:[1]

1. **Label** two pieces of card stock with a letter (A, B). Smear the card stock on one side with petroleum jelly.

2. **Tape** the sheets next to each other on the outside of a window, smear-sides out. Do this when it isn't raining or snowing. Keep track of the location.

3. **Take** one sheet in after one day and the other in after one week.

Before Class: Set up carousel:

4. **Tape** 4 or 5 pieces of chart paper around the room. At the top of each paper, write a key phrase:

- Cut down on burning fossil fuels
- Choose renewable sources of electricity
- Use less electricity
- Avoid burning
- Shop with renewable resources in mind
- AQHI

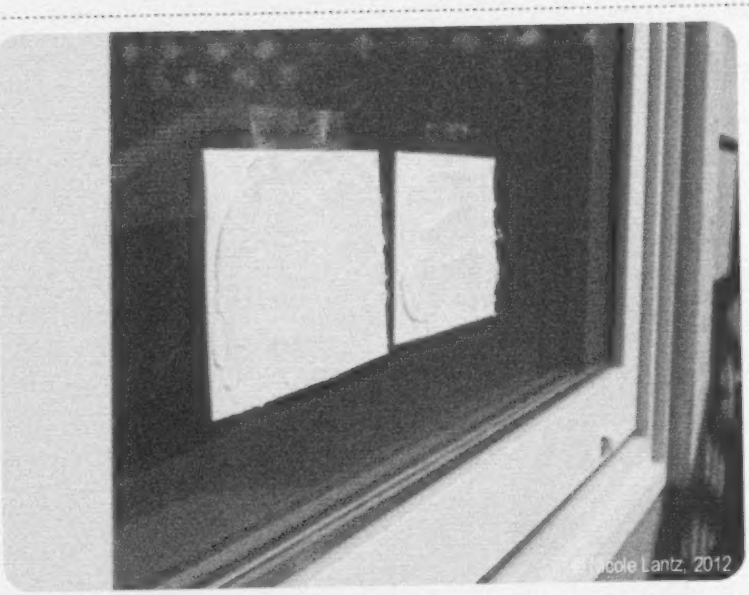
5. **Divide** the paper in half below it. On the left side, write "List"; on the right side, write "Draw".

Setting the Stage and Elicitation (5 min)

6. **Show** students the jelly-smeared papers or jars.

7. **Show** the class the template in Hands Up (Overhead). Ask them to trace their hand onto a piece of paper and label each finger as indicated.[2]

8. **Think:** Ask students to think silently about what they see on the jelly-smeared papers and write their ideas on the handprint.



9. **Pair:** Ask students to partner to chat for one minute about their ideas.

10. **Share:** Call on two or three individuals to share with the class.

Restructuring: Carousel (30 min)

11. **Divide** students into groups of five (5) or less and provide with a marker at their home base.

12. **Read** the Carousel Instructions.

13. **Direct** the activity until they are back to their home groups.

14. **Pass out** the appropriate Carousel Reading A, B, C, D, or E to each home group.

15. **Ask** students to read the article and read over their chart, indicating which items are correct or incorrect.

16. **Ask** each group to stand up and share their final ideas with the class.

Application and Conclusion (20 min)

17. **Pass out** Air Quality Report. Ask students to complete the assignment in class or finish it at home.

18. **Show** students the jelly-smeared papers or jars again. Ask them to take out their original hand-tracings.

19. In a full-class discussion, **ask** students for environmental actions, scientific information, and technologies that could help solve the problem(s) the jelly-smeared papers represent.

Adaptation

- Smear petroleum jelly on white card stock and place inside jars.
- Put the jars in different locations, including those where you expect visible air pollution.
- Label the jars with the location.

Carousel Instructions

- Today we are going to do a carousel. As you can see, there are pieces of chart paper around the room.
- In groups, you will rotate around the classroom to each piece of chart paper.
- Here, you will brainstorm everything you know about the topic, keyword, or phrase.
- The trick is that you will have 30 seconds less time for each brainstorm. We will switch after 2 minutes at your home base, 1.5 min at the next chart paper, then 1 min, and only 30 seconds at the final station.

Credits

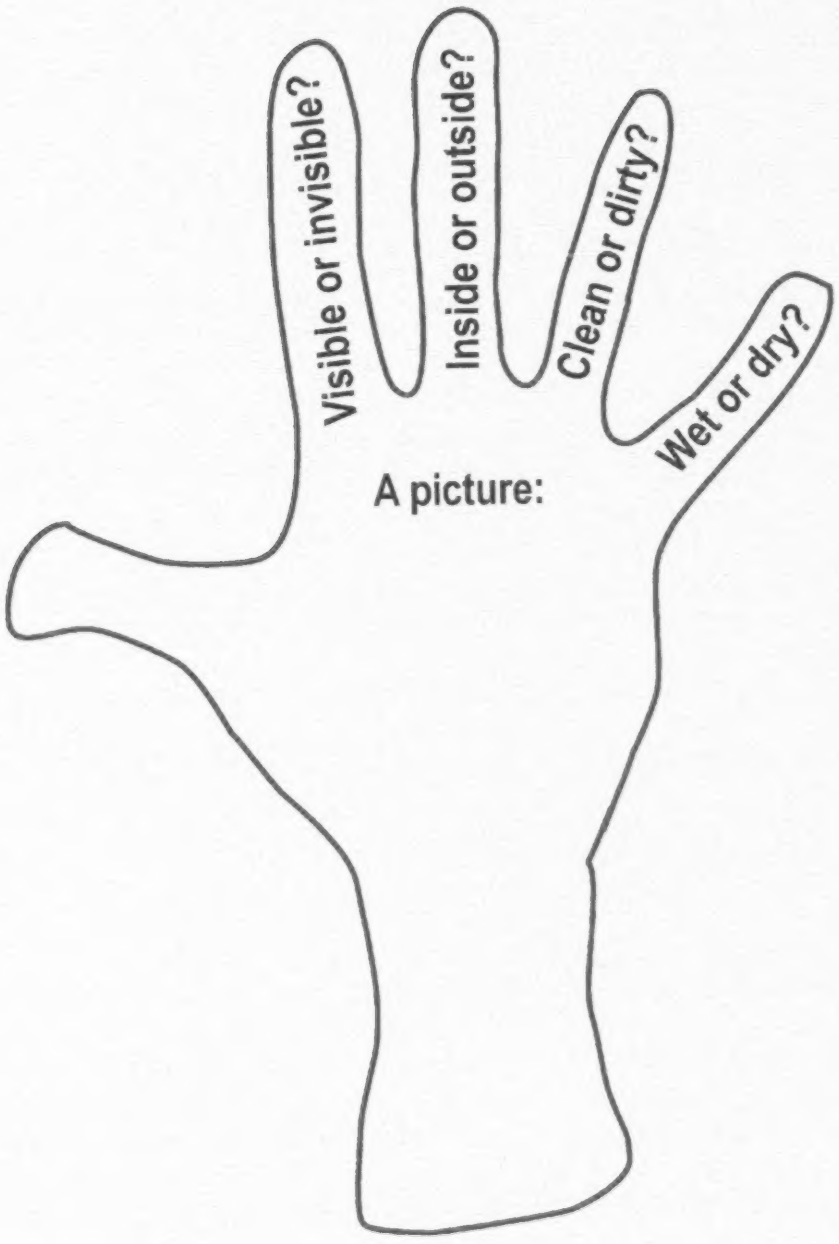
[1] Adapted from Jones, M. (1995). Lesson Plans for Teachers. Texas Commission on Environmental Quality.

[2] Adapted from Preszler, J. (2006). On Target: Strategies that Differentiate Instruction. SD Dept. of Education. www.decd.sa.gov.au/northernadelaide/files/links/9Strategies'IhatDifferentia.pdf

Environment Canada. *Air Quality Health Index*. Revised Dec. 2011. www.airhealth.ca.

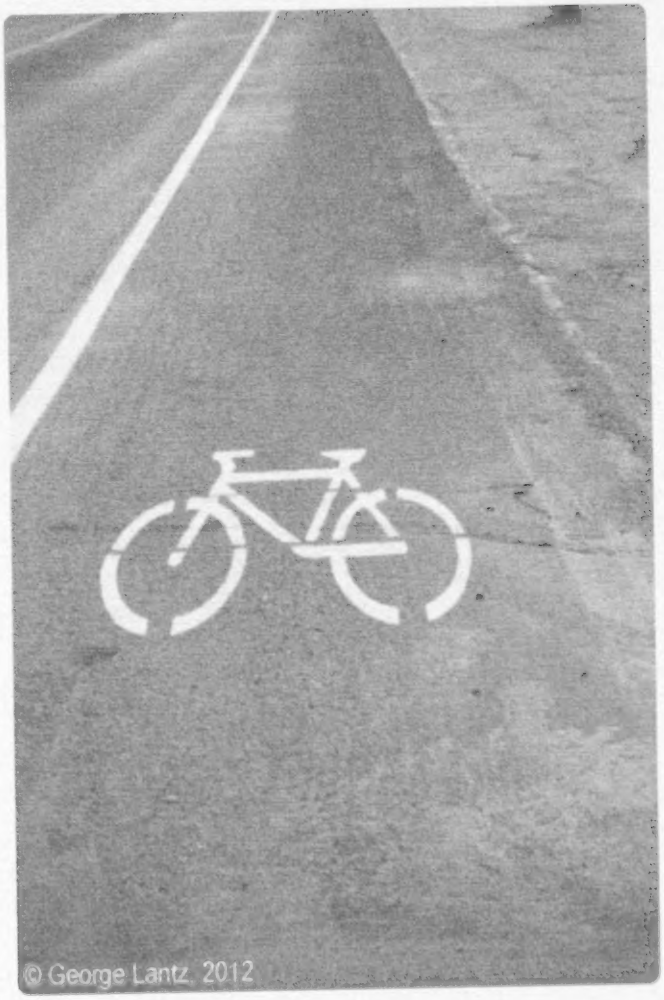
Hands Up

ask


Visible or invisible?
Inside or outside?
Clean or dirty?
Wet or dry?
A picture:

act

A. Cut Down on Fossil Fuels



Instead of burning fossil fuels like oil, coal, and natural gas to get you moving, why not burn the energy stored in your body from the food you eat?

Walk

Walking and running are the most sustainable modes of transportation. They are good for the environment and are also part of a healthy lifestyle.

Cycle

Prevent **air pollution** by cycling or roller-blading back and forth to school. Remember to wear a good helmet and clothes that drivers can see.

Take public transit

Public transit can be a form of independence as you get older. You can freely travel in an area, it is affordable, and it saves a lot of energy! Why not learn the routes and road safety now with an adult?

Carpool

Organize a carpool with friends, school, or teammates.

Ask adults not to idle

Turn off a vehicle if it will be sitting still longer than 10 seconds. Remember, the best way to warm up a vehicle is to drive slowly for the first five kilometres.

Reduce the use of gas-powered tools

The engine in a gas-powered lawn mower produces eight times the pollution that a car engine does. Use a push lawnmower instead, a rake instead of a leaf blower, and clippers instead of a weed eater. You'll get more exercise and less noise!

Keep the heat down

Keep the heat no higher than 20°C during the day, and turn it down when you're out or asleep.

act

Create a walking school bus

A walking school bus is a group of children walking to school with one or more adults. It can be two families taking turns, or it can be volunteers who walk along a route with meeting points.

Zap It!

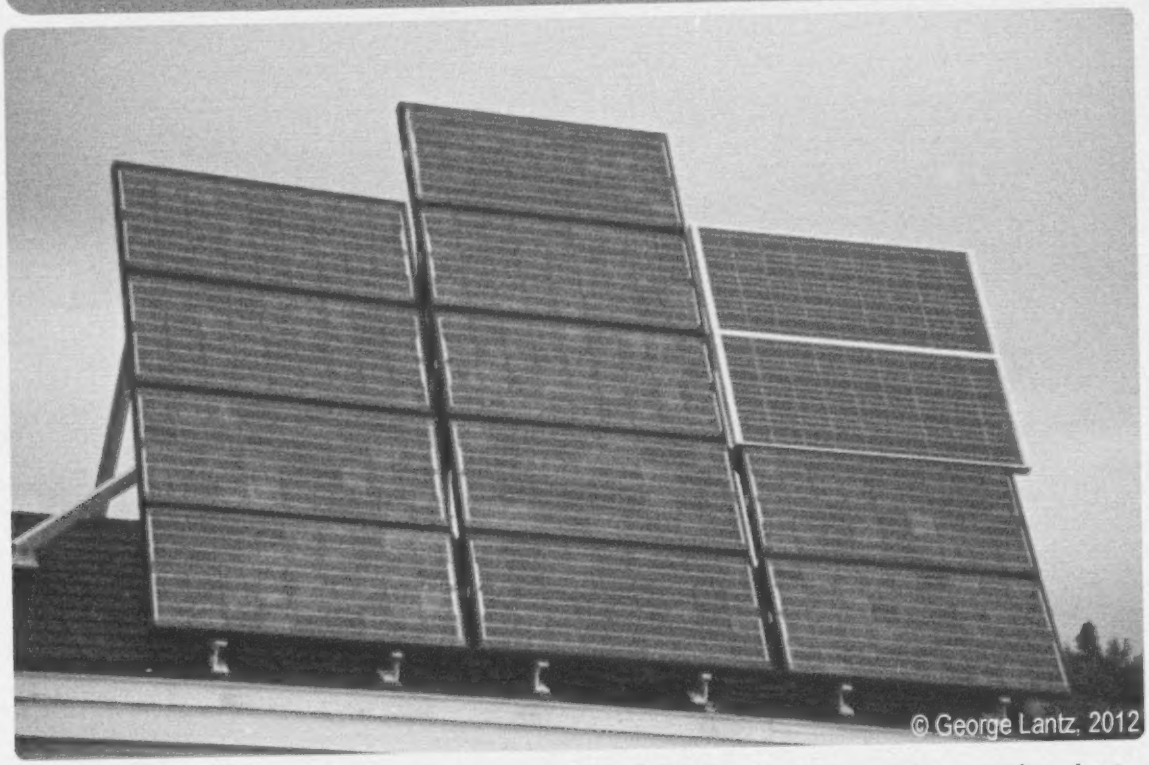
If all Canadians avoided idling for just five minutes every day, we could prevent more than 2,000,000 tonnes of carbon dioxide from entering the atmosphere.

That's like taking 380,000 cars off the road!

How will you convince adults to turn off the key?

act

B. Choose Renewable Sources



If you want to make electrical energy, you must start with another form of energy.

Think about how **electricity** is generated. Imagine the power lines leaving your school extending all the way to a power generation station somewhere. You might even know where it is.

When you imagine this power generation station, does it look like a box with long stacks spitting out smoke? Or is it a field full of windmills? Perhaps it is a building connected to a dam? Or **solar** panels on the roof?

If you want to make electrical energy, you must start with another form of energy. You can choose **renewable** sources of energy or **non-renewable** sources of energy as your starting point. Most of the time this energy turns a wheel or turbine (mechanical energy) and generates electricity (electrical energy, or power). Sometimes the energy is captured and stored in other ways, such as **solar** panels that capture light energy. Scientists are always trying to develop new technologies that efficiently capture, store, and convert energy.

act

Renewable Natural Resources Used to Generate Electricity

Instream-powered

Tidal-powered

Wind-powered

Hydro-powered

Biomass-fueled

Geothermal-powered

Solar-powered

Non-Renewable Natural Resources Used to Generate Electricity

Natural gas-fueled

Oil-fueled

Coal-fueled

Nuclear-powered

Type of Energy

- Light Energy
- Energy of Height or Position (Potential)
- Energy of Motion (Kinetic)
- Heat Energy

Zap It!

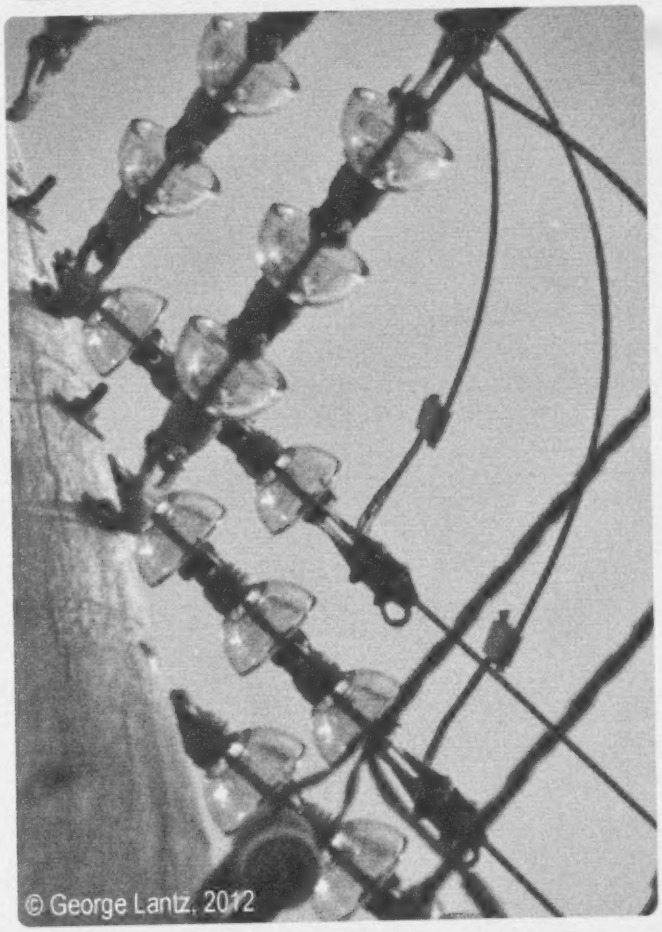
To generate electricity, you need:

- A source of energy (heat, light, potential, or kinetic energy)
- A technology to capture, store, and convert the source energy into electrical energy

Is it better to look for a new source of energy or a new technology?

act

C. Use Less Electricity



Set it and forget it: use sensors or other technologies that automatically turn off or turn down things that use electricity.

Turn off lights when you don't need them

You can save electricity (and money) by turning off the lights when no one is using them. You may even want to use sensors that automatically turn lights on/off.

Turn down the heat when you don't need it

It's always a good idea to set your thermostat to lower the temperature when no one is at home. You'll create less air pollution whether you use electric heating or another form of heating, such as oil.

Use energy-efficient light bulbs

If you could get the same amount of light using less electricity, would you? That's exactly what you can do. It's simple. A 60W incandescent bulb uses much more electricity than an 8 or 9W LED light bulb, even though it produces the same amount of light. Switch to energy-efficient light bulbs and use task lighting instead of keeping all the lights on.

Hot water

Some hot water tanks use electricity to heat the water. Turn down the hot water tank and it will use less. A leaky hot water tap can waste up to 13,000 litres of water a year. If the faucets are fixed, they'll save energy used to heat the water in the hot water tank.

Keep your clothes clean and green

When possible, hang clothes out to dry instead of using a dryer. Think about how much electricity a dryer uses compared to fresh air! If you use electricity for hot water, wash your clothes in cold water. When you're buying a new washer or dryer, consider buying low-energy ones.

Turn off your machines

Turn off or unplug your computer and television when they are not in use. It's best if you set them up to automatically go into sleep mode in case you forget.

Use a fan

Instead of cranking the air conditioner, try a fan. Or, if you must, tune the air conditioner at 1 or 2 degrees warmer than usual.

act

D. Avoid Burning

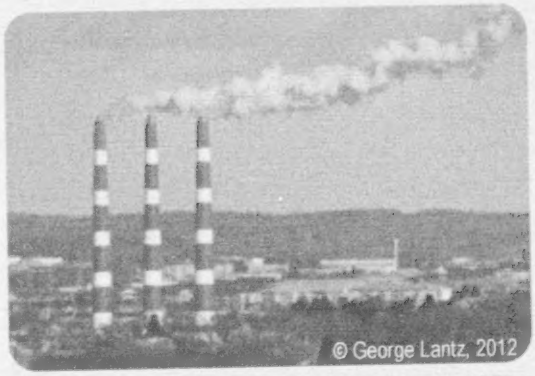
If your yard gets covered in leaves and clippings, start a backyard compost instead of burning. Both the air and your garden will benefit. If your town has a community compost program, you can put your organic leftovers in the compost bin.

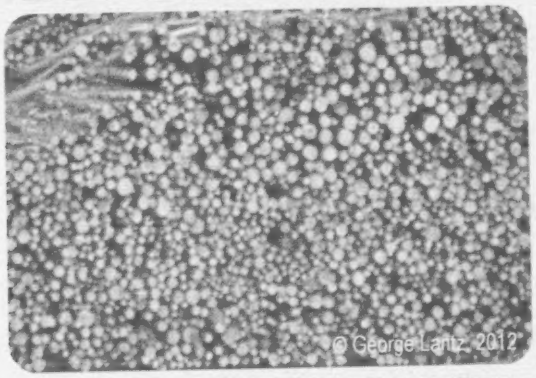
Reduce waste at its source by avoiding over-packaging, and recycle everything you can. Never burn plastics, tires, painted wood, and other garbage. They release toxic substances.

When using a wood stove or fireplace, make sure the burning is efficient so that it releases the least possible amount of smoke.

Tips for using a Wood Stove

- Check the **AQHI** before you consider burning. Never burn when the **AQHI** is already high.
- Make sure your wood is properly seasoned in a dry place for at least six months. Wet wood produces lots of smoke.
- Don't burn wood that's treated or painted. The same goes for driftwood. Driftwood smoke includes dioxins, which are highly toxic.
- Don't overload your stove with too much wood or starve the fire of air.
- Don't burn when the smoke won't leave the area (e.g., during a temperature inversion).
- Be aware of the no-burn periods in your community, and follow the rules.





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Did You Know?

Particulate matter (PM) comes from burning, regardless of whether it is a **renewable** or **non-renewable resource.**

$PM_{2.5}$ is the biggest concern because it is so small that it travels all the way to the alveoli in the lungs. This is especially risky for at-risk populations such as children.

That is why $PM_{2.5}$ is one of the three pollutants measured for the **AQHI**.

www.airhealth.ca

act

E. Think Renewable

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When you buy something, think about the full life of the product. What is it made of? What are the raw materials – are they renewable or non-renewable? Are they local or from another part of the world?

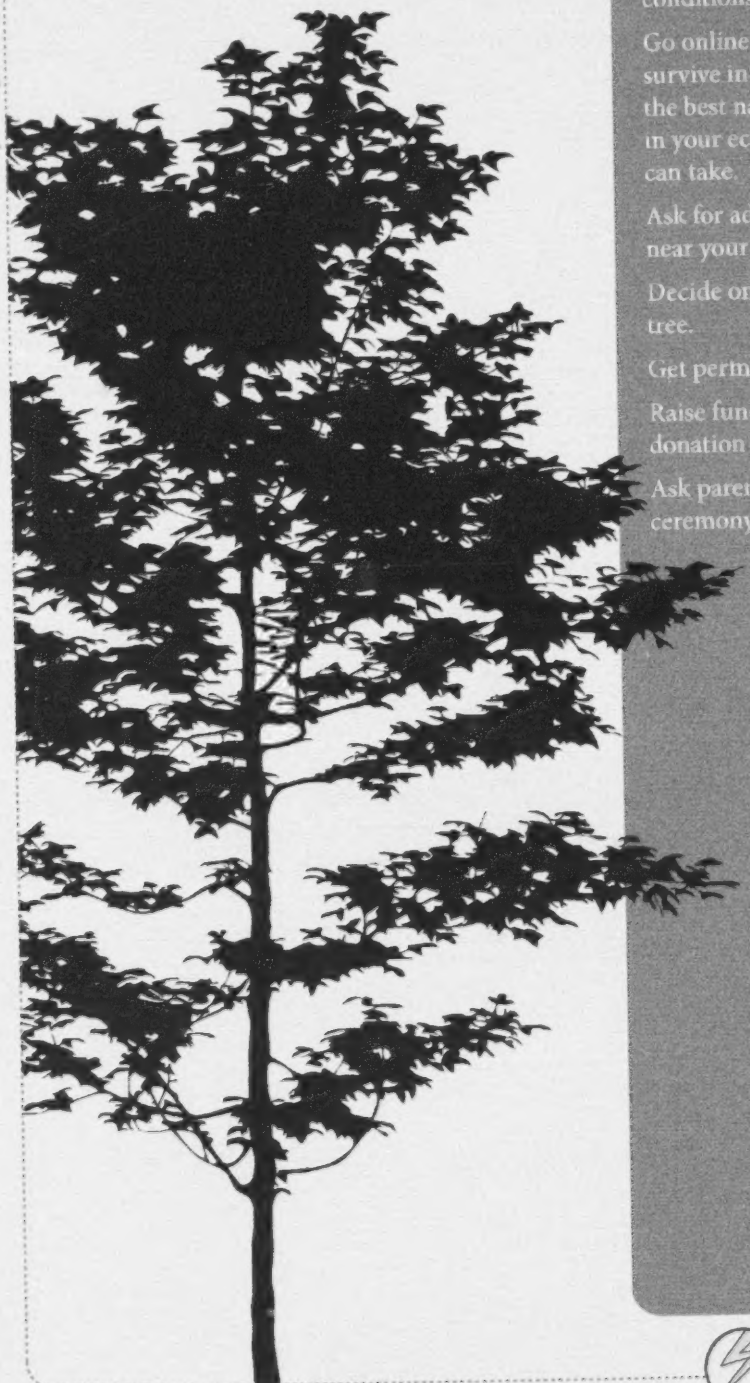
Think about the steps needed to bring an item to you. What **renewable** or **non-renewable** resources are used to extract and process the raw materials? What resources are used to manufacture the product and distribute it to stores and to you?

What about when you use it? Is it something you can reuse or recycle or does it end up in a landfill?

If possible, buy local products made from **renewable** resources. Try to pick ones without much packaging. The average meal travels 2,500 km to our plate. To get there, the elements of the meal probably travelled by fossil-fuel-based transportation, such as motor vehicles, planes, trains, and marine vessels. When we buy local products, we cut down the travel time of that product, which helps to decrease pollution, including **air pollution.**

Even if you do use products from **renewable** resources, remember that they need to be renewed! Plant a tree or garden at home or school. Trees and plants absorb carbon dioxide, a greenhouse gas, and convert it to oxygen, which we

need to breathe. (This process is called photosynthesis.) They are also natural air filters, breaking down pollutants and reducing dust. Trees provide shade and cool buildings in the summer without air conditioning. They provide shelter from **wind** in the **winter**.



act

Plant a Tree

Invite a nursery representative to come talk about different kinds of trees, and in what conditions they like to grow.

Go online to find out what trees need to survive in your ecozone, and which trees are the best natural air filters. If trees cannot live in your ecozone, think of another action you can take.

Ask for advice on the ideal place to grow a tree near your school.

Decide on an appropriate dedication for the tree.

Get permission from the principal.

Raise funds, apply for grants, or seek a donation from local businesses.

Ask parents to join in for a dedication ceremony.

Assignment

Environmental actions are really just choices that consider the environment.

Most of the time people are trying to make the best choices with the information and technologies they have. The key is to update our choices over time.

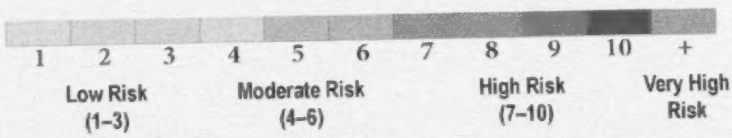
1 Think about a choice you make now that people couldn't have made 5, 20, 50, or 100 years ago. Then, imagine what you will think in twenty years about some of the choices you make today.

Focus on how your choices impact air quality. It can be a ***direct impact*** or an ***indirect impact***, based on how products or services are made, stored, distributed, used, and discarded. Think about the **renewable** or **non-renewable** resources that were used (or saved) because of the choice.

2 Fill out the mini-report (p.34) to describe the scene of a good or poor choice for the environment, big or small, past or present.

Consider the following information about the **AQHI** and remember that you can check your local **AQHI** on Environment Canada's Weather website:

- Environment Canada and Health Canada developed the **AQHI** because **air pollution** poses risks to the environment *and* health.
- The AQHI is based on **particulate matter** ($PM_{2.5}$), **ground-level ozone** (O_3), and **nitrogen dioxide** (NO_2).
- You can't always see these pollutants, so check the **AQHI** in the daily forecast.
- When the **AQHI** is high, the risk is high.
- You can make active lifestyle choices based on the **AQHI**. If the **AQHI** is low, it is ideal for outdoor activities. If the **AQHI** is high, you may need to choose outdoor activities that are less strenuous.
- The **AQHI** includes health information for everyone, including groups at risk.
- For more information about the **AQHI**, go to www.airhealth.ca.
- To check your local **AQHI**, go to Environment Canada's Weather website, www.weather.gc.ca.



Health Risk	AQHI	Health Messages	
		At Risk Population	General Population
Low	1–3	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities.
Moderate	4–6	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing or throat irritation.
High	7–10	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High	Above 10	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

Choice: _____

Check one:

☐ Good choice with today's information and technology

☐ Poor choice with today's information and technology

Location: _____

Pollutant: _____

Source: _____

Check natural resource involved:

☐ Renewable ☐ Non-renewable

Check one or more correct boxes.

☐ You can tell the AQHI by looking at the air.

☐ You can tell the AQHI by looking it up online.

☐ You can tell the AQHI by smelling the air.

Describe the air quality at the scene.

List or draw:

How will this choice affect health?

Check who is affected:

☐ humans

☐ other mammals

☐ other animals (e.g. birds, fish)

Check what system(s) are affected:

☐ respiratory

☐ circulatory

☐ skeletal

☐ immune

☐ digestive

Check how long it will affect health:

☐ short term

☐ long term

What would you say or do to further improve the choices made in this situation? _____

Enrichment Activity

Organize a Walk to School Day at your school

The goal of a Walk to School Day is to get as many students taking alternative kinds of transportation as possible. Walking is one way, but cycling and rollerblading are also good.

- Identify safe routes to school and discuss essential rules for walking safely.
- Include cycling and other transportation alternatives.
- Discuss your ideas with the principal, teachers, and parents.
- Designate a day – perhaps during International Walk to School Week (early October), Earth Day (April 22) or Clean Air Day (first Wednesday in June).
- Set up a friendly challenge with another school or competitions among different classes.
- Make posters and take-home flyers. Be clear that young children must be accompanied by an adult.
- Ask parents to greet students who walk, take pictures and perhaps give out stickers or ribbons.
- Keep a tally of how many students come to school without driving, and how many students per class.
- Give out prizes to the winning class or school.

Zap It! Answers

Lesson 1

p.13

Good ozone is above the clouds. It is in the stratosphere, which is above the troposphere. Bad ozone is below the clouds. It is at ground-level.

p.15

Young children are included in the sensitive groups because on a per-body-weight basis they tend to inhale relatively more air than adults. Their elevated metabolic rate and young defence systems make them more susceptible to air pollution.

p.17

Answers will vary. Students should consider the pros and cons of energy sources, such as current and future supply, cost, safety, environmental impact, emissions, and the ability to produce it within Canada (energy security).

p.19

Labels from top to bottom: PM_{10}, $PM_{2.5}$.

Pollution can dissolve in water to form acid rain.

Diffusion.

Lesson 2

p.25

Answers will vary. Students should consider researching social marketing strategies, such as incentives, personal communication, and neighbourhood leaders. Students should also consider ways they regularly influence their parents.

p.27

Answers will vary. Most students will argue that it is easier to develop a new technology than to find a new source of energy. In fact, most energy research is probably a combination of both. For example, at the University of Calgary, a chemical engineer is working to develop new technologies to use deep oil from the oil sands. At the same time, she is leading a team to explore gasification from dead trees – a promising source of clean energy.

National curriculum outcomes or expectations

Students will be expected to:

Alberta

Grade 5 Topic D – Weather Watch

- Recognize that human actions can affect climate, and identify human actions that have been linked to the greenhouse effect.

British Columbia

Grade 5

- Analyse how B.C.'s living and non-living resources are used;
- Describe potential environmental impacts of using B.C.'s living and non-living resources;
- Analyze how the Aboriginal concept of interconnectedness of the environment is reflected in responsibility for and caretaking of resources.

Grade 6

- Differentiate between renewable and non-renewable methods of producing electrical energy.

Manitoba

Grade 5, Cluster 1: Maintaining a Healthy Body

- 5-1-15 Explain how human health may be affected by lifestyle choices and natural- and human-caused environmental factors. GLO: B3, B5, C4, D1

Grade 6, Cluster 3: Electricity

- 6-3-1 Identify renewable and non-renewable sources of electrical energy, and discuss advantages and disadvantages of each. GLO: B5, E4

New Brunswick

Grade 5, Earth and Space Science: Weather; Environmental Issues

- Identify examples of weather phenomena that are currently being studied (105-1);
- Identify positive and negative effects of technologies that affect weather and the environment (108-1);
- Describe how studies of the depletion of the ozone layer, global warming and the increase in acid rain have led to new inventions and stricter regulations on emissions from cars, factories, and other polluting technologies (106-4).

Grade 6, Physical Science: Electricity

- Identify and investigate various methods of generating electricity (past, present and future), and describe some ways in which these methods affect the environment (303-28, 105-3, 108-8);
- Identify and explain sources of electricity as renewable or non-renewable (303-29);
- Identify and explain different factors that could lead to a decrease in electrical energy consumption in the home and at school, and how this will help protect the environment (108-5, 303-30).

Newfoundland and Labrador

Grade 6 Physical Science: Electricity

- Identify and explain sources of electricity as renewable or nonrenewable.
- Identify and explain different factors that could lead to a decrease in electrical energy consumption in the home and at school.

Northwest Territories

Grade 5: Conservation of Energy

- Distinguish between a renewable and non-renewable source of energy;
- Demonstrate an understanding of the importance of conservation of energy in relation to the wise use of renewable and non-renewable energy sources;
- Identify the forms of energy (e.g., mechanical, electrical) used in the home, school, and community and identify the energy source for each (e.g., wood, coal, moving water).

Grade 6 Electricity: Energy and Control

- Identify uses of electricity in the home and community and evaluate the impact of these uses on both our quality of life and the environment;
- Identify the different ways electricity is produced and evaluate the effect of different production methods on natural resources and living things in the environment.

Nova Scotia

Grade 5, Earth and Space Science: Weather; Environmental Issues

- Identify examples of weather phenomena that are currently being studied (105-1);
- Identify positive and negative effects of technologies that affect weather and the environment (108-1).

Grade 6, Physical Science: Electricity; Consumption and Conservation

- Explain various methods by which electricity is generated, including renewable and non-renewable (105-3,303-28, 303-29);
- Describe how our actions could lead to reducing electrical energy consumption in our environment (108-5, 108-8, 303-30, 106-3).

Nunavut

Grade 5: Conservation of Energy

- Distinguish between a renewable and non-renewable source of energy
- Demonstrate an understanding of the importance of conservation of energy in relation to the wise use of renewable and non-renewable energy sources;
- Identify the forms of energy (e.g., mechanical, electrical) used in the home, school, and community and identify the energy source for each (e.g., wood, coal, moving water).

Grade 6: Electricity, Energy and Control

- Identify uses of electricity in the home and community and evaluate the impact of these uses on both our quality of life and the environment;
- Identify the different ways electricity is produced and evaluate the effect of different production methods on natural resources and living things in the environment.

Ontario

Energy and Control: Grade 5 – Conservation of Energy

Overall Expectation:

- Demonstrate an understanding of the importance of conservation of energy in relation to the wise use of renewable and non-renewable energy sources.

Specific Expectations:

- Distinguish between a renewable and a non-renewable source of energy;
- Formulate questions about and identify needs and problems related to protection of the natural environment, and explore possible answers and solutions;
- Describe how we use different natural resources as sources of energy and evaluate the effect of their use on natural and human-made environments.

Energy and Control: Grade 6 – Electricity

Overall Expectation:

- Identify uses of electricity in the home and community and evaluate the impact of these uses on both our quality of life and the environment.

Specific Expectations:

- Formulate questions about and identify needs and problems related to the properties or uses of electrical energy;
- Identify sources of electricity and state whether the sources are renewable or non-renewable.

Prince Edward Island

Grade 5, Earth and Space Science: Weather; Environmental Issues

- Identify examples of weather phenomena that are currently being studied (105-1);
- Identify positive and negative effects of technologies that affect weather and the environment (108-1);
- Describe how studies of the depletion of the ozone layer, global warming and the increase in acid rain have led to new inventions and stricter regulations on emissions from cars, factories, and other polluting technologies (106-4).

Grade 6, Physical Science: Electricity

- Identify and investigate various methods of generating electricity (past, present and future), and describe some ways in which these methods affect the environment (303-28, 105-3, 108-8);
- Identify and explain sources of electricity as renewable or non-renewable (303-29);
- Identify and explain different factors that could lead to a decrease in electrical energy consumption in the home and at school, and how this will help protect the environment (108-5, 303-30).

Quebec

Essential Knowledges: Cycle 2 and 3 – Earth and Space

Competency #1:

- To propose explanations for or solutions to scientific or technological problems.

Energy, Sources of Energy (Cycle 2 and 3)

Transformation of Energy

- Renewable forms of energy (Cycle 2);
- Non-renewable forms of energy (Cycle 3).

Saskatchewan

Grade 5, Physical Science: Weather (WE)

- WE5.3 (Indicator C) Analyze the impact of weather on society and the environment, including technologies that help humans address weather conditions.

Grade 6, Physical Science: Understanding Electricity (EL)

- EL6.1 Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts. [CP, DM]

Yukon

Grade 5

- Analyze how the Yukon's living and non-living resources are used;
- Analyze how the Aboriginal concept of interconnectedness of the environment is reflected in responsibility for and caretaking of resources;
- Describe potential environmental impacts of using the Yukon's living and non-living resources.

Grade 6

- Differentiate between renewable and non-renewable methods of producing electrical energy.

Alberta Education Elementary Science (1996)
www.education.alberta.ca/media/654825/elemsci.pdf

British Columbia Ministry of Education (2005)
www.bced.gov.bc.ca/irp/pdfs/sciences/2005scik7_5.pdf

Manitoba Ministry of Education
www.edu.gov.mb.ca/k12/index.html

New Brunswick Department of Education
www.gnb.ca/0000/anglophone-e.asp#cd

Newfoundland and Labrador Elementary Science Curriculum
www.ed.gov.nl.ca/edu/k12/curriculum/guides/science/elementary/gr5.pdf

Northwest Territories Department of Education
www.ece.gov.nt.ca/

Nova Scotia Department of Education
www.ednet.ns.ca

Nunavut Department of Education
www.edu.gov.nu.ca

Ontario Ministry of Education
www.edu.gov.on.ca/eng/curriculum/elementary

Prince Edward Island Department of Education
www.gov.pe.ca/eecd/index.php3?number=1025899&lang=E

Quebec Ministére de l'Education, du Loisir et du Sport
www.mels.gouv.qc.ca/DGFJ/dp/programme_de_formation/primaire/educprg2001h.htm

Saskatchewan Ministry of Education
www.edonline.sk.ca/webapps/moe-curriculum

Yukon Department of Education
www.education.gov.yk.ca

www.ec.gc.ca

Additional information can be obtained at:

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